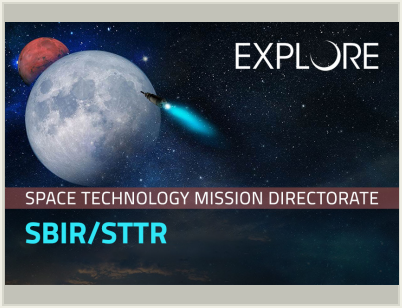
Enhanced Reliability MEMS Deformable Mirrors for Space Imaging Applications, Phase I

Completed Technology Project (2011 - 2011)

Project Introduction

The goal of this project is to develop and demonstrate a reliable, fault-tolerant wavefront control system that will fill a critical technology gap in NASA's vision for future coronagraphic observatories. The project outcomes include innovative advances in component design and fabrication and substantial progress in development of high-resolution deformable mirrors (DM) suitable for space-based operation. Space-based telescopes have become indispensible in advancing the frontiers of astrophysics. Over the past decade NASA has pioneered coronagraphic instrument concepts and test beds to provide a foundation for exploring feasibility of new approaches to high-contrast imaging and spectroscopy. From this work, NASA has identified a current technology need for compact, ultra-precise, multi-thousand actuator DM devices. Boston Micromachines Corporation has developed microelectromechanical systems (MEMS) DMs that represent the state-of-the-art for scalable, small-stroke high-precision wavefront control. The emerging class of high-resolution DMs pioneered by the project team has already been shown to be compact, low-power, precise, and repeatable. This project will develop a system that eliminates the leading cause of single actuator failures in electrostatically-actuated wavefront correctors ➪ snap-through instability and subsequent electrode shorting and/or adhesion. To achieve this we will implement two innovative, complementary modifications to the manufacturing process. We will develop a drive electronics approach that inherently limits actuator electrical current density generated when actuator snap-down occurs, and we will modify the actuator design to mitigate adhesion between contacting surfaces of the actuator flexure and fixed base electrode in the event of snap-down. Phase II research will combine the actuator design and fabrication processes, and current-limiting drive electronics to produce a MEMS DM with 3072 actuators with enhanced reliability.



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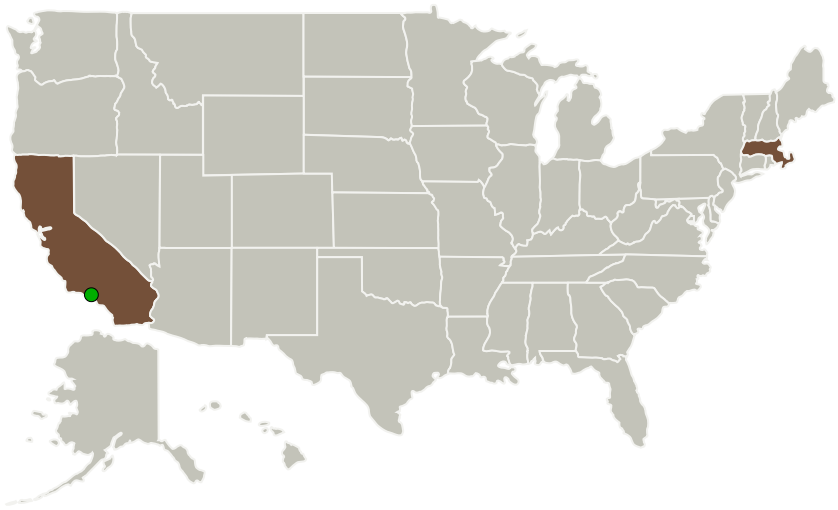
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Boston Micromachines Corporation	Lead Organization	Industry	Cambridge, Massachusetts
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations	
California	Massachusetts

Project Transitions

February 2011: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Boston Micromachines Corporation

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Steven A Cornelissen

Co-Investigator:

Steven Cornelissen

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September 2011: Closed out

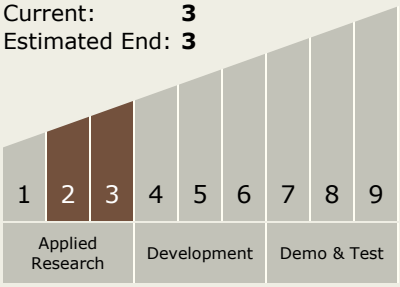
Closeout Summary: Enhanced Reliability MEMS Deformable Mirrors for Space I maging Applications, Phase I Project Image

Closeout Documentation:

- Final Summary Chart Image*(https://techport.nasa.gov/file/140205)*

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.2 Observatories
    - TX08.2.1 Mirror Systems

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System